1940 Russian Model Engine Book

Written and officially approved for publication in 1939, this little book appeared in print in 1940. It is largely confined to the presentation of plans and instructions for building the PP-4 spark ignition motor (bore 19.5 mm, stroke 19.5 mm, displacement 5.82 cc), which was closely based upon the design of the 0.364 cuin. (5.96 cc) Baby Cyclone of 1935 from the USA. By way of open acknowledgement, a photograph showing the Baby Cyclone actually appears as an illustration in the book. The engine is thus the first recorded Russian "clone", of which many more were to appear later.

The engine was certainly in existence by 1937, since it won a contest during that year. It is not known whether or not it was ever produced in series. Russia's entry into WW2 in June 1941 would have put an end to any such venture in any case.

The book contains next to nothing else of any historical interest, hence the incomplete translation.

P. Pylkov

GASOLINE MOTORS

Central Bank of the Komsomol

CHILDREN'S LITERATURE PUBLICATIONS

Leningrad, 1940

Author's Note

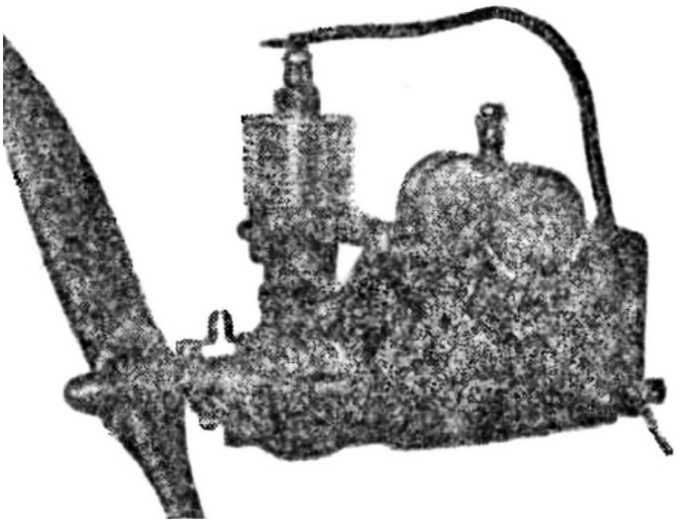
The PP-4 motor described here was designed by the engineer P.V. Pylkov of Leningrad. When designing the motor, note was taken of the designs of US model engines. A model built by Comrade Petrov using a PP-4 motor set an all-Union distance record of 14,370 m at the 1937 model aircraft competitions in Koktebel.

How a Motor Works

For any first-time constructor of this engine, we assume a prior acquaintance with the operating principles of internal combustion engines, so here we provide only a brief description of the functioning of a model aero motor in order to highlight some of its features.

The PP-4 two-stroke engine

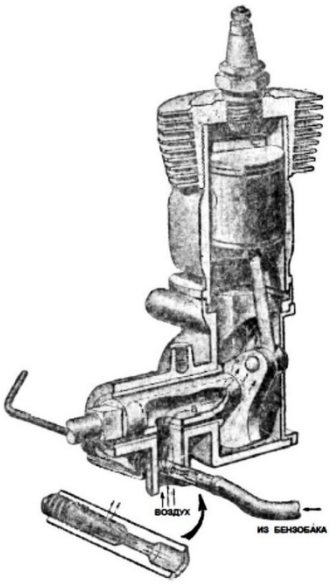
The motor described here is a gasoline-powered internal combustion engine having a cylinder displacement of 5.82 cc. Among these engines, four-stroke and two-stroke types are distinguished, both working on a mixture of gasoline and oil. Our motor is a two-stroke. This means that the whole operating process - preparing a mixture of air and gasoline, feeding it into the cylinder, burning it and discharging the spent mixture (combustion products) - occurs in one revolution of the crankshaft, or in two piston strokes, one each up and down.



The features of our motor include a coil and fuel supply system which are approximately the same as in the American Baby Cyclone motor illustrated at the left.

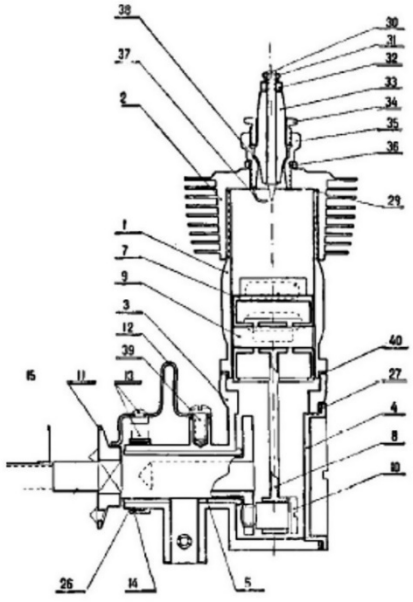
General description

At the end of the book is a tab (Appendix, Sheet I). Unfold it and follow, using the numbering in the description. A sectioned view showing the engine's internal arrangements is seen at the right.



The cylinder consists of a sleeve 1 and a head 2 screwed onto it with cooling fins. A spark plug is screwed into the head. The cylinder is attached to the crankcase with two screws passing through the flange.

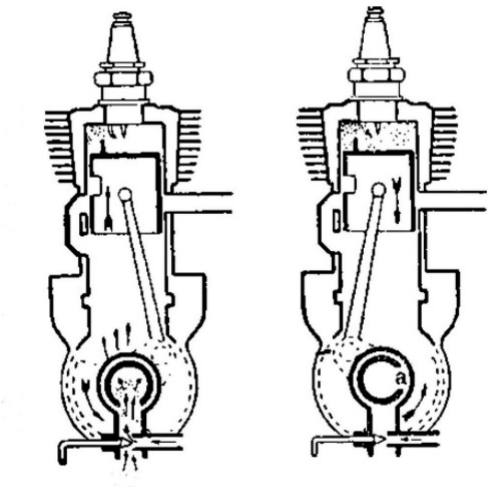
The crankcase 3 is cast from aluminum alloy. A bronze bushing is pressed into the front crankcase extension - the crankshaft bearing 5. At the rear, the crankcase has a screw-in backplate 4. The crankshaft 6 rotates in the crankcase bushing and is connected to the piston 7 through the connecting rod 8. The crankcase is attached to the model frame with four screws 23 (see the drawing). The forward end of the crankshaft is extended to accommodate the contact breaker cam 11.



The carburetor mounted on the main bearing housing of the crankcase consists of a spraybar with a jet 17, its needle 18 with a locking device and a vertical air intake tube. The gas tank is mounted on the motor mounting frame. The propeller is installed on the shaft and secured with a nut 16. An exhaust stack 25 is attached to the cylinder to remove exhaust gases. The bypass channel is formed by a stamped cover 21.

How the motor operates

Unscrew the carburetor needle 18 by one and a half turns. From the jet 17 gasoline will start to drip. With a quick but not abrupt movement of the hand, turn the airscrew counter-clockwise, viewed from the front. The following sequence will take place. The piston, rising up, will create a vacuum in the crankcase. At a certain point, a hollow crankshaft connects the crankcase and the intake tube through a port created in the shaft surface. Since the pressure in the crankcase at this moment is lower than atmospheric, air rushes through the intake at high speed, capturing droplets of gasoline vapor, and enters the crankcase.

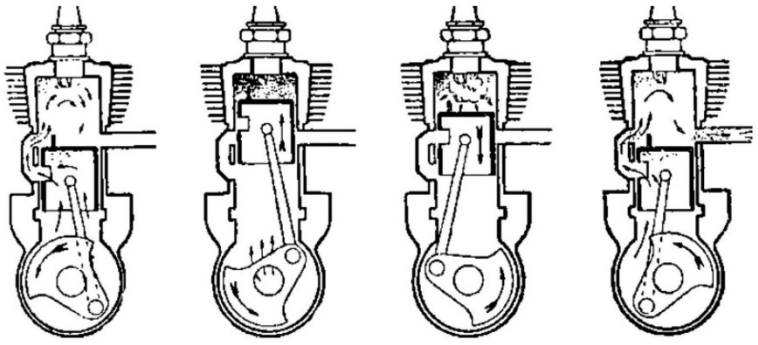


The piston reaches top dead center and begins to move down. At this point, the crankshaft port closes, separating the crankcase from the intake tube. These phases are illustrated at the right.

Descending further, the piston compresses the mixture in the crankcase. As it approaches bottom dead center, the crankcase becomes connected with the bypass passage through holes in the piston and cylinder walls. At the same time, the transfer port at the top of the bypass passage is opened by the piston. Since at this moment the pressure in the crankcase is one and a half to two times higher than atmospheric pressure, while in the cylinder it is atmospheric or only slightly elevated, the mixture is ejected from the crankcase into the cylinder, filling it.

The piston now rises again. Beneath it, a vacuum is again created in the crankcase, and a new portion of fuel mixture is sucked into the crankcase when the shaft port opens once more.

When the exhaust port closes, the mixture is compressed above the piston. The piston now approaches top dead center. The contact breaker opens, and a spark jumps the gap of the spark plug, igniting the mixture. The burning mixture greatly increases the gas pressure in the cylinder. This pressure is transmitted to the piston, forcing it to move down, driving the crankshaft through the connecting rod.



Beneath the piston, the mixture is again compressed after entering the crankcase. At the moment when the piston opens the transfer port, the compressed mixture rushes

into the cylinder and fills it, forcing the combustion products out through the exhaust port. This sequence is illustrated above at the left.

Subsequently, the whole process is repeated as long as there is gas in the tank and the ignition is working. The engine can be stopped by cutting off the fuel supply, by leaning out the mixture or by turning off the ignition.

The speed is regulated by adjusting the carburetor needle and the ignition timing. With an increase in the amount of gasoline (within certain limits), the number of revolutions will increase to 4,000 per minute, and the power developed on the shaft can reach 0.20 horsepower.

(Editor's note - the following sections detail the construction of the engine using methods which are very familiar to present-day model engineers, including the casting and machining of the sand-cast crankcase. Since the plans were not reproduced during the scanning process, this section has been omitted as being of no practical value).

Assembly and Test

Let us now proceed to the assembly of the motor, which must be carried out in distinct stages. During assembly, we constantly check the fit of individual parts and, if necessary, customize them by additional reworking.

a) ***Cylinder***

Screw the head onto the cylinder liner. Before doing this, grease the thread, not forgetting to install the gasket in the head (Fig. 56). Having screwed down the head, heat the cylinder to 250 ° and re-tighten it. Then after allowing the assembly to cool, wash everything in gasoline and lubricate with oil.

b) Piston

Having inserted the connecting rod with the upper end into the piston, press in the gudgeon pin and then make two central punches on both sides. Thus, the pin is fixed in the piston.

c) Final assembly

Having inserted the piston with the connecting rod into the cylinder and the crankshaft into the crankcase, put the cylinder on the crankcase (remember to include the gasket) and secure it with two screws. Having inserted the crankpin into the lower end of the connecting rod (the end into which the bronze bushing was previously pressed), screw it into the web of the crankshaft. Continue with the rest of the assembly as shown on the drawings.

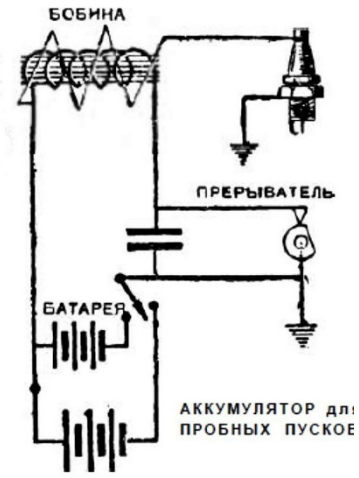
Set the contact breaker so that the points begin to open about 15 degrees before top

dead centre. This should be a good setting for the initial start. The points gap when open should be around 0.5 mm.

d) Running in

Before starting, run the motor in the cold state. To do this, remove the spark plug, connect the shaft of the assembled engine to an electric motor, lathe chuck or other drive and spin the shaft, pouring oil into the cylinder. From time to time try to rotate the engine by hand. As soon as the shaft rotates easily by hand without binding, the cold break-in can be considered complete. Remove the cylinder, wash all parts in gasoline, carefully lubricate with oil and put the cylinder back in place. Install a propeller on the shaft, connect the gas tank to the carburetor and proceed to start.

e) Starting



Clamping the motor in a test stand, assemble and connect the electrical circuit according to the attached figure. A suitable power source is two or three flashlight batteries (always fresh) connected in parallel

Fill the tank with a mixture of one part of MS oil and four parts of gasoline. Open the needle valve half a turn.

Turning the motor shaft several times with the plug unscrewed but with the wires connected to it, make sure that a strong spark jumps the plug gap. A few turns with a finger placed over the air intake will draw fuel into the crankcase. Install and connect the plug, switch on the ignition circuit and proceed to start.

To start, flick the airscrew hard against compression to rotate the shaft rapidly in the direction of operation. After each flick, unscrew the needle a little more until the engine begins to fire. When the motor starts to run continuously, it is necessary to adjust the needle and contact breaker timing to achieve the highest possible speed.

f) Malfunctions

A variety of malfunctions may be encountered. For example, the motor may initially run at a high speed but may then begin to slow down (*sagging*). This usually means that the engine has not yet been run in sufficiently and as the shaft or piston in the cylinder heat up, they become tight. More running in time with a rich needle is required. In extreme cases, the fits may have to be relieved by dismantling the engine for further processing.

There may be another directly opposite reason for the same behavior. If the piston is too ***loosely*** fitted, the motor may work initially due to the viscosity of the oil at starting temperatures, but as it heats up, the oil becomes less viscous, ceasing to properly seal

the gap between the piston and the cylinder. The resulting loss of compression stops the motor. In this case, you can hear a characteristic hissing sound of air passing between the piston and the cylinder wall when the motor is turned over by hand. Under such circumstances, a new piston will have to be made.

Other possible malfunctions include ignition system component damage, bad electrical connections, interrupted fuel supply and others. These can be easily detected and corrected without special instructions.

It is necessary to monitor the condition of the spark plug. A large gap between its electrodes leads to a failure in the operation of the plug, since in this case the spark does not jump across the spark gap under the gas pressure in the cylinder. This also happens due to the formation of carbon deposits on the plug's electrodes, fouling them. In addition, a short circuit may develop through the excessive deposition of carbon on the insulator. By removing the plug and washing it with denatured alcohol, this malfunction can be eliminated.

(*Editor's note - a description of making a coil and a condenser follows. This has been omitted from this translation as serving no practical purpose for today's enthusiasts. The rest of the book is wholly taken up with plans and drawings, which are incomplete in the available scan from a Russian source*).

Responsible editor A. Abramov, approved for publication September 1939.